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Patterns of G- and C-bands distribution on chromosomes of three *Apodemus* species

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Abstract

Compared the chromosomes of three species of genus *Apodemus: Apodemus agrarius, A. sylvaticus* and *A. flavicollis* by means of G- and C-banding techniques. The characteristics of G-banding are identical for 19 pairs of autosomes and for sex chromosomes. The distribution of crossbands on all chromosomes of *Apodemus sylvaticus* and *A. flavicollis* appeared to be quite the same. The karyotypes of the previous two species and that of *A. agrarius* are different in four pairs of small metacentrics which have arisen by pericentric inversions from chromosomes 16, 19, 22 and 23. The C-bands are restricted to the centromeric area in all the species studied.

Introduction

From numerous descriptions of karyotypic variation in mammals which appeared in the last three decades it seems that there exist two major groups of animals according to the degree of karyotypic differences. The smaller group consists of species whose karyotypes appear to be very uniform, and the bigger group includes species which are karyotypically very different. The differences between these two groups can be explained by biological factors i.e. reproductive potentials and social structure of species (Arnson 1972; Fredga 1977).

Karyotypes made by standard techniques have often been used as the measure of the degree of chromosomal variation (Wilson et al. 1975; Bush et al. 1977; Bengtsson 1980). Detailed studies of patterns of G- and C-bands, which now exist for some groups, show that magnitude of chromosomal variation in some cases is much greater than it was thought at the time when karyotypes were investigated solely by conventional techniques.

By using methods of differential staining Haiduk et at. (1981) found that in eight species of African megachiropterans karyotypic variation is 4.5 times greater than it was suggested by standard karyotypic studies.

Three species of genus *Apodemus,* which by standard techniques appeared to be karyotypically very similar, are studied in this work by means of G- and C-banding techniques. The genus *Apodemus* is widespread over the Palaeartic. According to Martens and Niethammer (1972) it is divided into three subgenera: *Apodemus, Sylvaemus* and *Alsomys.* In this work three species have been examined: *Apodemus agrarius* Pall. which belongs to subgenus *Apodemus; Apodemus sylvaticus* L. and *Apodemus flavicollis* M. both of which belong to subgenus *Sylvaemus.*

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Material and methods

Five animals (3 ♂, 2 ♀) from each species, collected from natural populations, were used for this study. Specimens are captured at three distant localities in Yugoslavia: Jastrebac, Brezovica and Mokrc.

Chromosome preparations were done directly from bone marrow using the standard technique. G-bands were induced with trypsin and stained with Giemsa according to SEABRIGHT (1972). C-banding followed the original schedule of ARRIGHI and HSU (1971) with the omission of the RNA-se step.

A minimum of ten spreads were examined to ensure consistency of banding patterns within each specimen. For the analysis only complete spreads were used.

Results

All three species have diploid number 2n = 48 (MATTHEY 1936; ŽIVKOVIĆ et al. 1966; SOLDATOVIĆ et al. 1971; KRAL 1972). The only difference which could be seen on conventionally stained chromosomes is that *Apodemus agrarius* had four pairs of small metacentric chromosomes compared to the two other species in which all 48 chromosomes are acrocentric.

C-band are in all three species located exclusively in centromeric region (fig. 1). There seem to be no intersticial or terminal heterochromatic blocks, either on autosomes or on sex chromosomes.

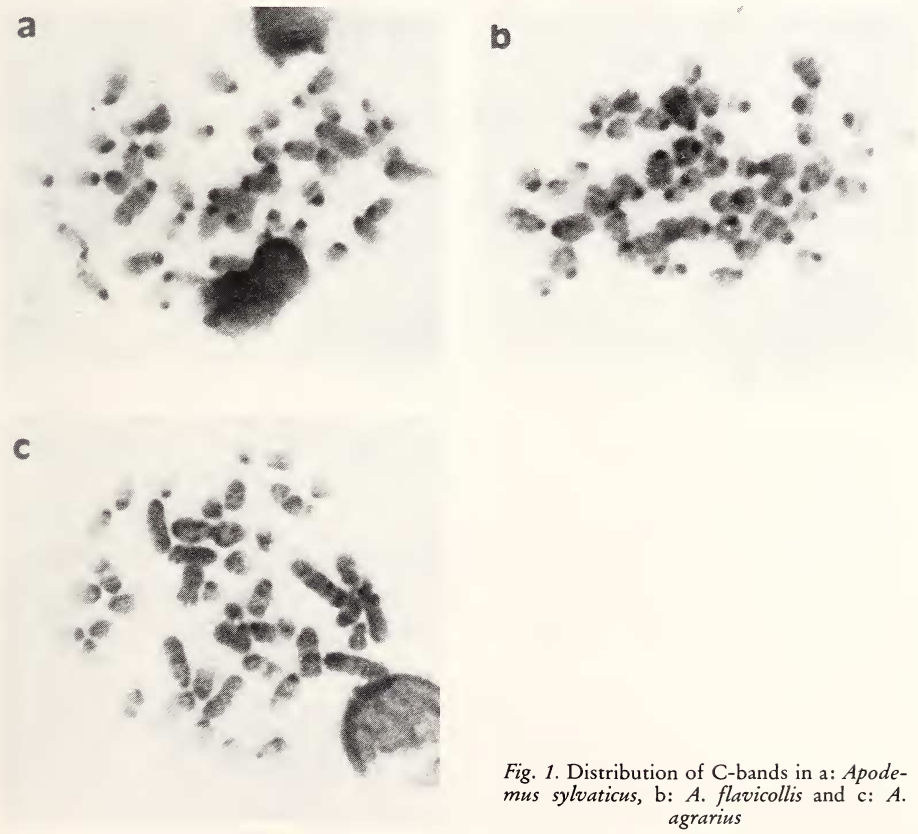

Fig. 1. Distribution of C-bands in a: *Apodemus sylvaticus*, b: *A. flavicollis* and c: *A. agrarius*

After G-band procedure it was possible to identify each pair of chromosomes in all three species. The comparison of distribution of G-bands on chromosomes of all three species shows that only minor differences exist between them (fig. 2).

Nineteen pairs of autosomes and sex chromosomes are common to all the species studied. When *A. sylvaticus* and *A. flavicollis* are compared alone it appears that they have

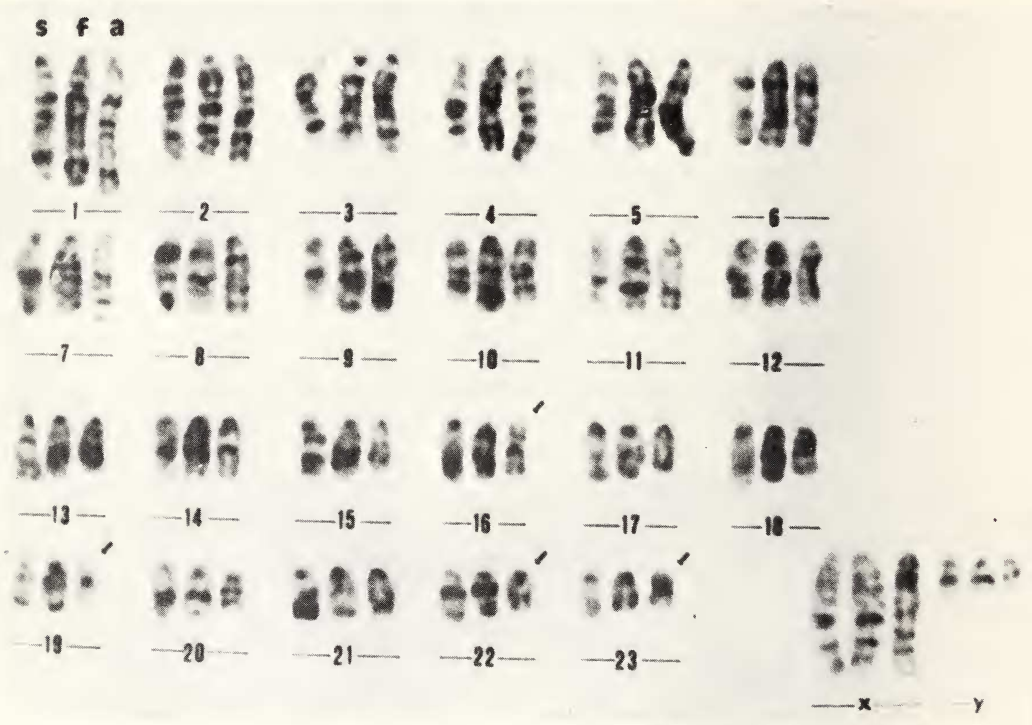

Fig. 2. The comparison of distribution of G-bands on chromosoms of s: *Apodemus sylvaticus,* f: *A. flavicollis* and a: *A. agrarius*

the same distribution of crossbands on their chromosomes. The only apparent differences between *A. agrarius* and the previous two species are reflected on four pairs of chromosomes which in *A. agrarius* appear as small metacentrics. These are chromosomes number 16, 19, 22 and 23 (marked with arrows in fig. 2). The absence of heterochromatic blocks on short limbs of these small metacentrics and the distribution of the crossbands on them indicate that they have arisen as a result of pericentric inversions.

X chromosome is the longest one in karyotypes of all three species, and the distribution of G-bands on it is identical for all of them. Y chromosome is on the other hand one of the smallest chromosomes and in all species studied it has one dark band in the middle of the longer arms.

Discussion

Our results are mostly, but not quite, in agreement with results of Soldatović et al. (1975) and Bekasova et al. (1980). Bekasova et al. found that *A. agrarius* and *A. sylvaticus* differ in five pairs of chromosomes and in our material these differences are found on four pairs

of chromosomes. After application of G-banding technique they concluded that X chromosome of *A. agrarius* is of the middle size. In all our specimens X chromosome was the longest one in the karyotype or the same size as the first pair of chromosomes.

From results obtained by means of relative measurements of chromosome length, Gamperl et al. (1980) concluded that there must be additional chromosome segments on small autosomes of *A. sylvaticus* resulting from the presence of telomeric heterochromatic blocks. In our material we did not find telomeric C-bands on the chromosomes of *A. sylvaticus*. The difference between our results and those of Gamperl et al. probably comes out as a result of the fact that different techniques for obtaining C-bands were used.

Cytogeneticists, with few exceptions, have found a different karyotype for every rodent species studied. Our results show that the process of speciation in Rodents is not always accompained with great chromosome rearrangements. We found that karyotypes of *A. sylvaticus* and *A. flavicollis*, which are regarded as sibling species, are indistinguishable even after exploration of banding patterns distribution.

From results of comparison of banding patterns in eight Rodent species Mascarello et al. (1974) concluded that there exists a tendency for conservatism in the arrangement of genetic material in Rodents. The very high correlation between banding patterns which we found in three *Apodemus* species implies that this kind of conservatism could be present in this and possibly some other groups of Rodents.

Zusammenfassung

Die Verteilung von G- und C-Bandenmustern auf den Chromosomen bei drei Apodemus-Arten

Die Chromosomen von *Apodemus sylvaticus, A. flavicollis* und *A. agrarius* wurden mit Hilfe der G- und C-Bändertechnik verglichen. Die G-Bänder stimmen bei *Apodemus sylvaticus* und *A. flavicollis* völlig überein. Bei *Apodemus agrarius* weichen sie nur auf den vier Paaren kleiner Chromosomen ab, die im Gegensatz zu *sylvaticus* und *flavicollis* metazentrisch sind. Sie belegen, daß dieser Unterschied auf perizentrische Inversionen zurückzuführen ist. C-Bänder finden sich bei allen drei Arten ausschließlich in der Centromerenregion.

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Nesting behaviour of the Indian Gerbil, *Tatera indica indica*

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Abstract

Observed the nesting behaviour of Indian gerbil, *Tatera indica indica* Hardwicke. 18 adult subjects (6 ♂, 6 ♀, 6 pregnant ♀) chosen from a wild-caught stock, were housed individually and provided with bond paper sheets for nesting. The nests made were sketched, measured and weighed on alternate days.

Apparently, three type of nests are constructed. "Sleeping" nests made by males (mean diameter = 21.1 ± S.E. 0.4 cm) differ in size and shape from nests made by non-lactating females (mean diam. = 17.8 ± S.E. 0.5 cm); while "dome" like "Brood" nests elaborated by lactating gerbils are of a different type than "sleeping" nests (mean diam. = 16.0 ± S.E. 0.6 cm).

Various methods, including shredding of nesting material, are used for constructing the nests. Latencies to rebuilding of nests when scattered, vary widely; minimum latencies are shown by lactating gerbils (< 3 min).

Introduction

Nest-building in rodents is important both for breeding and thermo-regulation (Morgan and Stellar 1950; Barnett 1975). It has been widely studied in respect to both; though more of laboratory rats and mice than wild rodent species (Barnett 1975). Nothing is, however, known about the nesting behaviour of Indian gerbil, *Tatera indica indica* Hadwicke. Observations made on nesting activities of captive subjects, are discussed here.

Material and methods

Observations were made during the warmer periods, in the months of April and May.

Adult gerbils (body weight > 100 g) for the experiments were selected from wild-caught stock. Of the total 18 subjects six were males, six non-lactating females and six lactating females. The gerbils of the former two groups were housed in wire-mesh enclosures, 1.32 × 1.00 × 0.32 m or 0.75 × 0.35 × 0.35 m. Pregnant females were kept in all-glass aquaria, 0.9 × 0.45 × 0.35 m. The side-walls of cages and aquaria were covered with black paper. All gerbils were given a diet of cereals and cabbage; with ad lib. water.

Bond paper sheets, 29 × 29 cm, were provided to each gerbil for nesting. The cages were checked daily. On alternate days, the resident gerbil was trapped and removed from the cage. The nest found

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